IT is necessary to know more concerning the precise conditions under which the images referred to above were obtained before one can discuss them with safety; but they are interesting as apparently indicating that the axis of the trunk discharge *may* be free from metallic particles.

In this connection, however, it must be added that when one directly observes a negative discharge over a photographic plate from an electrode of zinc or magnesium, every line in the fan-like discharge is seen to have the bluish tint characteristic of the metal. Whatever, then, may be the reason for the absence of these fan-like figures from Mr. Lermantoff's images, it must certainly not be attributed to the absence of metallic particles from them.

ALFRED W. PORTER.

An Interesting Occultation.

MAY I direct attention to an interesting phenomenon which will take place on the morning of July 27, viz. the occultation of the star η Geminorum by the planet Venus, the particulars of which are as follows:—

Apparent place of η Geminorum (mag. 3·2–4·2), July 26, R.A. 6h. 9m. 26·6s.; dec. 22° 32′ 6·24″ N. Apparent place of Venus (geocentric), July 26, 14h. 57·7m. G.M.T., R.A. 6h. 9m. 26·6s., dec. 22° 32′ 7·2″ N. Declination at Greenwich, corrected for parallax, 22° 32′ 2·3″. Semidiameter 6·14″. At Greenwich the occultation commences at 14h. 55m., and ends at 14h. 58m. The planet rises at 13h. 43m., and the sun at 16h. 17m.

On the afternoon of July 28, Venus is in very close conjunction with μ Geminorum, the positions of the two bodies at 4h. 27m. being as follows:—

♀. R.A. 6h. 17m. 30·9s., dec. 22° 33′ 58″ N., declination (corrected for parallax) 22° 33′ 53″. μ Geminorum, R.A. 6h. 17m. 30·9s., dec. 22° 33′ 43″. As the semidiameter of the planet is 6·1″, the star will be within about 4″ from the southern limb. This, of course, occurs during daylight, but the planet will be above the horizon at the time. It sets about 6h. 8m.

Dr. Crommelin has kindly looked through these figures and verified them.

ARTHUR BURNET.

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Pwdre Ser.

THE curious belief that shooting stars, when fallen to earth, become lumps of jelly may possibly be explained in the following manner:—

The jelly is very probably the plasmodium of a Myxomycete, such as Spumaria or Physarum. The plasmodia occur most frequently in damp weather, but are found in lesser numbers throughout the year. Shooting-stars are also seen at all times in the year, but most plentifully in the autumn. In these islands, the greatest rainfall is also in the autumn months.

Consequently, by a purely fortuitous coincidence, meteors and plasmodia are most plentiful in the latter part of the year, the former because the main meteor swarms, in their annual revolution, cross the earth's track at that time, and the latter on account of the greater rainfall. Two striking phenomena are forced on the rustic attention at the same time, the brilliant display in the sky and the mysterious jelly on the grass. Very naturally the two are considered as causally connected, and so the belief may have arisen. An analogous case is that of "cuckoo-spit," the frothy exudation of the larval frog-hopper, *Philaenus spumarius*, which appears at the time of the arrival of the cuckoo and disappears about the period of the bird's departure.

W. B. GROVE.
E. MILLARD GRIFFITHS.

University Botanical Laboratory, Birmingham.

IN connection with the article on "Pwdre Ser" in NATURE of June 23, it is interesting to find, in Admiral Smyth's "Sailor's Word-Book"—one of the richest repositories of quaint facts and fancies—the term "fallen-star" defined as "A name for the jelly-fish or *medusa*, frequently thrown ashore in summer and autumn."

C. FITZHUGH TALMAN.

U.S. Department of Agriculture, Central Office of the Weather Bureau, Washington, D.C., July 11.

HOUSE-FLIES AND DISEASE.

ALTHOUGH the verification of the belief that the commonest, most widely distributed and truly domestic of insects, *Musca domestica,* Linn., was capable of carrying the germs of certain infectious diseases has been one of the noteworthy accomplishments of medical science in the last decade, it is a mistake to attach all the credit to those who, within the last few years, have removed the idea from the realms of hypotheses into the world of facts.

As early as the seventeenth century, Sydenham associated unhealthy conditions with flies. Lord Avebury, in 1871, regarded flies as "winged sponges spreading hither and thither to carry out the foul behests of contagion." In addition to other early suggestions, Nicholas, in 1873, indicated the possible connection of flies with the dissemination of cholera from a case observed by him in 1850; Raimbert in 1869 experimentally proved that the house-fly and blowfly were able to transmit the anthrax bacillus; Davaine in 1870, and Bollinger in 1874, also showed that the blowfly could carry the anthrax bacillus, an important practical observation. Laveran in 1880 demonstrated the ability of flies to carry the infectious discharge of conjunctivitis in Egypt on their proboscides and legs. All these observers assisted in

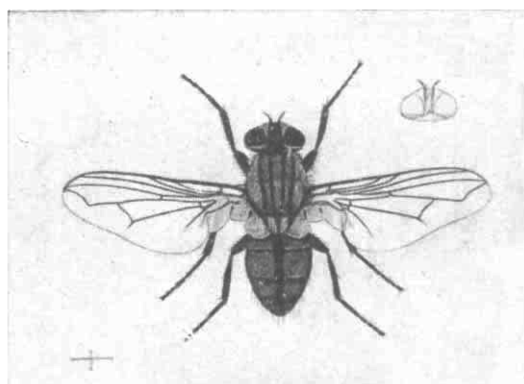

FIG. 1.—*Musca domestica*, Linn.

the gradual growth of the belief; but it was in the 'eighties of last century, however, that several investigators adduced more convincing bacteriological proof as to the ability of flies to carry pathogenic and other bacteria. In 1886, Tizzoni and Cattani obtained the cholera spirillum from flies caught in cholera wards. In the same year, Hoffmann found tubercle bacilli in the excreta of flies caught in a room which had previously contained a phthisical patient. Two years later, Celli showed that the typhoid bacillus was able to pass in a virulent condition through the digestive tract of the fly.

Since the above observations, which are selected from many others, were made, it has been repeatedly shown and proved that house-flies are able to carry these and other bacterial and fungal organisms. What has not been demonstrated is the extent to which flies are *not* able to carry such micro-organisms. When the habits of flies are considered, it is not a little remarkable that no serious attention was paid to the possibility of flies having any considerable relationship to the dissemination of disease until within the last twelve years. The excessive mortality from typhoid which occurred in the Spanish-American war was the means of directing the attention of such observers as Vaughan and Veeder to the possible relationship of flies to this disease, especially as

statistics showed that water was not a sufficiently important factor in, and was not explanatory of, the typhoid epidemics occurring in certain of the national encampments. Later, in the South African war, the same conditions were present, and enteric fever was responsible for a very heavy death-roll; those who were present directed attention on their return to these conditions, which, as circumstantial evidence, would convince the most sceptical as to the important *rôle* that flies played in the spread of the disease. These conditions are well known now; open latrines swarming with incredible numbers of flies in all stages of development; these latrines frequented by incipient cases of enteric; myriads of flies in the mess tents, defiling all kinds of food, and in many cases distinguishable by the lime which they bore on their appendages from the latrines, as were the typhoid patients in the hospitals also distinguishable by the number of flies clustering about their mouths while in bed.

From the setaceous character of the appendages and bodies of flies it is only to be expected that when allowed to have access to infected material they would be able to carry the bacilli on their appendages, bodies and in their digestive tracts, and the transference of flies from infected substances to culture media are really unimportant experiments compared with those of capturing the flies under normal conditions near sources of infection and determining the presence and identity of the micro-organisms on these insects, as certain investigators have done. It would

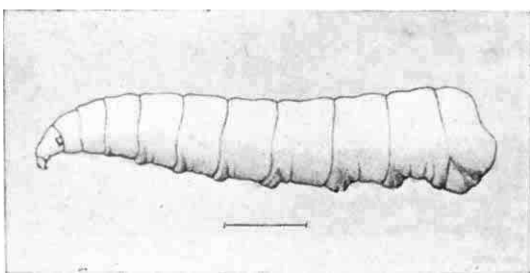

FIG. 2.—Larva of *M. domestica.*

be found impossible to obtain a specimen of *Musca domestica* which was not carrying bacteria or fungal spores.

Though externally they may be almost sterile when they emerge from the pupa, the fly after emergence immediately becomes contaminated, and during the remainder of its varied existence serves as a collector and disseminator of any bacterial or fungal organisms with which it comes into contact. One of the most important and convincing experiments is that of Güssow (hitherto unpublished), who obtained thirty colonies comprising six species of bacteria and six colonies comprising four species of fungi from a single fly caught in the living-room of a house and allowed to walk over a culture plate of agar-agar. From a fly caught in the open he obtained forty-six colonies comprising eight species of bacteria and seven colonies comprising four species of fungi. The tracks of a house-fly caught in a household dustbin yielded 116 colonies of bacteria comprising eleven species, and including such species as *B. coli, B. lactis acidi,* and *Sarcina ventriculi,* and ten colonies comprising six species of fungi.

Such experimental results render further argument as to the frequency with which house-flies carry bacteria and the spores of moulds and other fungi unnecessary. Flies captured near excremental products are most frequently found carrying bacteria characteristic of the alimentary canal or putrefactive bacteria, and it is only to be expected that should such sources of contamination be infected with pathogenic bacteria, for example, from an incipient case of typhoid or from a typhoid "carrier," the bodies of the flies would become infected. As an instance of this, Hamilton recovered *B. typhosus* five times in eighteen experiments from flies caught in two undrained privies, on the fences of two yards, on the walls of two houses, and in the room of an enteric fever patient, and others have obtained positive results in similar experiments.

The habits of these insects are most perfectly suited for the dissemination of pathogenic bacteria. On one hand, they seek all kinds of excrementous and decaying vegetable and other matter, chiefly for the purpose of depositing their eggs; and, on the other hand, they fly with perfect freedom on to food such as milk, sugar, &c., much of which forms an excellent medium for the deposition of whatever bacteria they may have become contaminated with during their ubiquitous wanderings.

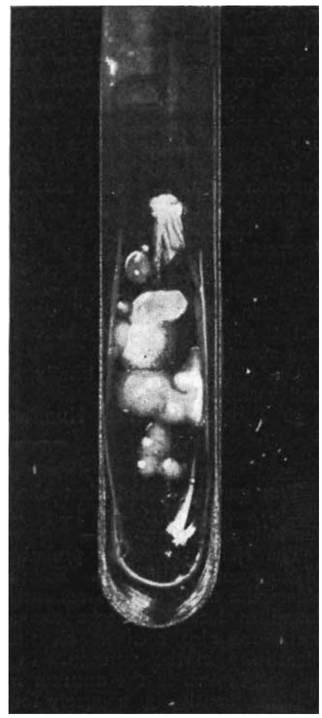

FIG. 3.—Agar-agar Slope culture of bacteria deposited by *M. domestica* in a single journey over the medium.

Not only during the summer, but also during the winter months, house-flies, if they are active, normally carry on their bodies and appendages bacteria and the spores of moulds, and Fig. 3 shows an agar slope culture obtained by allowing a fly caught in the writer's laboratory at the end of January, 1910, to walk up the agar slope; the comparatively large number of colonies which developed in the tracks of a single journey can be easily seen.

The eggs of the house-fly are deposited on most decaying vegetable substances, especially if they are in a fermenting condition; the influence of fermentation is of considerable importance; in one instance the maggots developed in germinating wheat. Of all substances they prefer horse manure, and this is most suitable for the development when it occurs in heaps as stable refuse, supplying as it does both moisture and heat, the two great essentials for a rapid development. They will also choose the excrements of man and certain other animals. Newstead found them in such animal and vegetable substances as rotting feathers, flocks, and paper, in which substances, when soiled with excrementous matter, they have also been found by the writer, and such conditions not infrequently occur in refuse heaps. Wherever there are collections of these substances, in such places will flies be found, not only depositing their eggs, but contaminating their appendages and bodies with putrefactive and other micro-organisms which abound there. Ficker and others have shown that typhoid bacilli can pass through the digestive tract

of the house-fly and retain their virulence for more than three weeks, but the more recent discovery by Faichne, that flies bred from larvæ which have developed in infected material carry the typhoid bacilli in their digestive tracts, is one of great importance in its practical bearing.

The most important factor which affects the numbers, activity, and potential danger of flies is temperature. Experiments show that at a high temperature the whole life-history can be passed in eight days. Further, it was found that the second generation of flies are able to begin to deposit their eggs as early as the fourteenth day after emerging from the pupa; in short, the second generation of eggs may be deposited in about three weeks after the deposition of the first. Each fly is able to deposit from 100 to 150 eggs in a single batch, and at least six batches are laid during the lifetime of a single female. It is not difficult, in view of these facts, to understand the production of enormous numbers of flies during hot weather, and how the activity and numerical abundance of flies increases with the rise of temperature. During the hot months of July, August, and September flies are most abundant, and it is a significant fact that in those years when the temperature is high during those months, that is, during the third quarter of the year, there is almost invariably a high mortality from typhoid fever and the infantile disease, summer diarrhœa. In connection with summer or infantile diarrhœa, a curve prepared from statistics covering the last twenty years showed, with the exception of one year, that a rise or fall in the number of deaths per thousand living in a large English city was associated with a rise or fall respectively in the temperature.

The relation of flies to summer diarrhœa is practically based on epidemiological and other circumstantial evidence, since the specific cause of the disease has not yet been determined with certainty. Morgan, however, has found a bacillus occurring in a large percentage of the cases of the disease, and the same bacillus has been isolated from flies captured in infected houses. An objection has been made to the idea that the house-fly is a carrier of the cause of summer diarrhœa, this objection being founded on the fact that at the end of the summer the fall in the fly curve follows the fall of the curve representing the diarrhœa mortality, the flies being still more numerous than they were earlier in the season, when the diarrhœa curve was rising. In meeting such an objection it may be pointed out that we are not considering the numerical abundance of the flies in the houses only; it should be remembered that with a decline of temperature the activity of the flies, especially out of doors, which is important in this case, is not so great, even though their numbers may be considerable indoors. With the fall of the temperature, therefore, the possibility of their carrying the infection decreases without a necessarily corresponding decrease in their numbers, and the diarrhœa curve will fall in consequence.

The fly problem, which is more serious in the United States and Canada than in England, is one that may be attacked and solved in cities and towns, provided that the authorities will take the necessary steps. As in districts previously infested with mosquitoes, these insects have been reduced to a negligible quantity by the abolition of their breeding-places or the rendering of the same unsuitable for the larvæ; so also the number of flies and their danger could be lessened very considerably by the removal of their breeding places, by preventing their access to the breeding places, or by treating these with substances noxious to the larvæ or flies. Flies are a public nuisance, and, therefore, to maintain places where flies are able to breed should be made a misdemeanour. Stable refuse should not be left exposed for a longer period than six or seven days in the summer, but should be removed from the vicinity of dwellings or treated with such a substance as chloride of lime, which will prevent the breeding of the flies, the refuse being kept in a closed fly-proof chamber. The presence of mews and stables with their exposed rubbish heaps will always account for the abundance of flies. The household dustbin or other repository for kitchen refuse, unless securely closed or screened and regularly emptied, also forms an excellent breeding ground. Public tips on to which all kinds of organic and decaying matter is deposited produce their flies in myriads; it is invariably found, where actual investigation has been made, that the percentage of cases of zymotic diseases of an enteric nature is abnormally high in the neighbourhood of public refuse tips and depôts where rubbish is allowed to accumulate.

In considering the relation of house-flies to disease, although the one species of fly, *Musca domestica,* usually constitutes from 90 to 98 per cent. of the fly population of houses, certain other species are also found to occur. The lesser house-fly, *Homalomyia canicularis,* has the next place in the scale of frequency, and is generally mistaken by the uninitiated for a young house-fly, on account of its general resemblance. Although both the adult fly and the larva have pronounced structural differences, the habits of the larva and the economic relationships of the fly resemble those of *M. domestica.* The blood-sucking fly, *Stomoxys calcitrans,* is not infrequently mistaken for the true house-fly, which has adopted vicious habits. *M. domestica,* however, is unable to pierce the most delicate skin, and *S. calcitrans,* which frequently enters and is found in houses in the spring and also in the autumn, especially in rural houses, presents considerable differences, the chief being the possession of an awl-like, piercing proboscis, a more robust build, and its coloration. Not infrequently inflammatory swellings, sometimes of a serious nature, result from the "bite of a fly," and such cases are instances of the mechanical transference of such bacteria as the Streptococci from infected material to a healthy human being by a blood-sucking fly. Malignant pustule may be caused by the mechanical transference of the *Bacillus anthracis* by a blood-sucking fly, or it may be by a non-blood-sucking fly, such as the blowfly, *Calliphora erythrocephala,* if the skin is broken to provide entrance for the bacillus.

Wherever there is filth, suppuration, or purulent discharge, flies are invariably attracted, and as they are cosmopolitan in their attentions and no distinguishers of persons, they are potential disseminators of such bacteria as these substances may contain. It is not a question of eradication in the case of this insect; such is impossible. Control and prevention, however, are within the bounds of possibility, and these will be regarded as essential when the facts are more generally realised. C. GORDON HEWITT.

THE NEXT TOTAL ECLIPSE OF THE SUN.

ON April 28 of next year there will occur a total eclipse of the sun which will begin on the earth generally at 7h. 49·2m. G.M.T., the central phase commencing at 8h. 46·1m. G.M.T. The path of the moon's shadow is restricted for the most part to the equatorial regions, and is confined to the longitudes between Australia and South America, so that as far as Europe or Asia are concerned the eclipse cannot be observed there even in a partial phase.

The actual line of central eclipse commences on